Personality dimensions of the captive California sea lion (Zalophus californianus)

Running Head: SEA LION PERSONALITY

Personality Dimensions of the Captive California Sea Lion (*Zalophus californianus*)

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Abstract

Although the field of animal personality research is growing, information on sea lion personality is lacking. This is surprising as sea lions are charismatic, cognitively advanced, and relatively accessible for research. In addition, their presence in captivity and frequent interactions with humans allow for them to be closely observed in various contexts. These interactions provide a valuable and unique opportunity to assess dimensions of their personality. This study created a personality survey for captive California sea lions (*Zalophus californianus*) using a three-step approach that balances comprehensiveness and comparability to other species. Zookeepers (N = 43) at 5 zoological parks rated sea lions (N = 16) on 52 personality traits and 7 training traits. A principal components analysis (PCA) and regularized exploratory factor analysis (REFA) revealed three dimensions (Extraversion/Impulsivity, Dominance/Confidence, and Reactivity/Undependability). Each dimension was significantly correlated with at least one training trait. Pups and juveniles scored significantly higher on Extraversion/Impulsive than adults. No other age or sex effects were present on this or any other dimension. Sea lions are cognitively complex marine mammals that represent a valuable addition to the group of species in which personality structure and function has been studied. The unique behavioral and ecological characteristics of sea lions offer another vantage point for understanding how personality varies between disparate species.

Keywords: social carnivore, pinniped, temperament, marine mammal, survey

Personality Dimensions of Captive California Sea Lions

As early as 40 years ago, researchers had begun developing standardized nonhuman animal personality measures (Gosling & John, 1999; Stevenson-Hinde & Hinde, 2011; Watters & Powell, 2012). The Big Five taxonomy (John, Naumann, & Soto, 2008) is a useful starting point because it posits that a large number of behavioral, cognitive, and affective tendencies (or traits) to be encompassed by five primary factors (Gosling & John, 1999). These factors include Neuroticism, Agreeableness, Extraversion, Openness to Experience, and Conscientiousness (John, Naumann, & Soto, 2008).

In nonhuman animals, traits related to Big Five factors can be measured using behavioral coding and/or trait ratings (Watters & Powell, 2012). Unlike behavioral coding, which involves recording the frequency of specific behaviors, rating can draw upon cumulative experiences with that animal (Freeman, Gosling, & Shapiro, 2011; Watters & Powell, 2012). These cumulative experiences are easily aggregated using the rating approach, which eliminates noise from different personal experiences of animal care personnel. For these reasons, primate personality researchers have suggested that the rating approach is superior to coding (Freeman et al., 2011). Although a combination of rating and coding approaches are considered best practice, the use of ratings alone is a robust approach (Freeman et al., 2011; McGarrity, Sinn, Thomas, Marti, & Gosling, 2016; Watters & Powell, 2012).

Two strategies have been used for creating personality surveys for use with nonhuman animals: “top down” and “bottom up” (Freeman et al., 2011; Uher, 2008). The “top down” approach stresses comparability and involves adapting existing surveys. However, it risks missing traits unique to the target species (Freeman et al., 2011). The “bottom up” approach is based on the behavioral repertoire of the target species, and therefore surveys developed using

this approach are often not comparable to those developed using this approach for other species (Freeman et al., 2011). To harness the strengths and counter the weaknesses of both approaches, Freeman et al. (2011) describe a three-step approach for developing nonhuman animal personality surveys. Briefly, Freeman et al.'s approach involves generating a list of behavioral traits from a variety of sources, eliminating redundancy in those traits, and defining the traits with respect to species-specific behavior. Once a new survey has been created and implemented, inter-rater reliability must be assessed for each trait, and traits that are not reliably assessed are removed from further analysis (Furr, 2011). Lastly, data reduction, either principal components analysis or factor analysis, is used to determine the components or latent variables that the traits define (Furr, 2011).

In this study we sought to characterize and assess personality dimensions in the California sea lion (*Zalophus californianus*). We chose to study captive sea lions due to their prevalence in zoos and aquariums, their advanced cognitive abilities (Gisiner & Schusterman, 1992; for review see Schusterman, Kastak, & Kastak, 2002), and their ability to form relationships with humans (Schusterman, Gisiner, & Hanggi, 1992). Their frequent interactions with animal care staff afford close observation of the animals in more than one context, making them ideal subjects for cumulative personality ratings. Sea lions are also social carnivores, linking them phylogenetically with dogs (*Canis familiaris*) and hyenas (*Crocuta crocuta*), two species in which personality has been previously studied (Gosling, 1998; Jones & Gosling, 2005). Gosling (1998) suggested that social carnivores might be of particular interest in personality studies due to their social sensitivity and ability to form relationships with humans. These attributes may cause social carnivores to share unique personality traits or suites of traits that are distinct from other groups. For example, Malassis and Delfour (2015) demonstrated that

California sea lions are able to exploit cues from humans. This led them to propose that the mechanisms that enable California sea lions to utilize human communicative gestures evolved in response to the socially complex environment they inhabit. Studying sea lions thus may offer another perspective on how interspecific social skills are manifested in personality.

California sea lion life ecology and social structure also make them interesting subjects for comparative personality research. California sea lions live in large social groups with a polygynous breeding system and show pronounced sexual dimorphism (Peterson & Bartholomew, 1967; Riedman, 1990). Males defend breeding territories on land that aggregations of females move between (Peterson & Bartholomew, 1967). Breeding females direct aggression at conspecifics of both sexes and all ages (Peterson & Bartholomew, 1967). Although there are no systematic studies on sea lion personality, field studies of another species of pinniped, grey seals (*Neophoca cinera*), provide evidence of individually different behavior (Twiss, Culloch, & Pomeroy, 2012; Twiss & Franklin, 2010). Specifically, males showed consistent individual differences in alertness during breeding seasons (Twiss & Franklin, 2010). A later study on both males and females showed that both sexes displayed consistent individual differences in approach and retreat behaviors to a foreign stimulus, and females showed individual differences in pup-checking behavior (Twiss et al., 2012).

Because we focus on the personality of captive California sea lions, it is important to note that the individuals in this study participate in training for the majority of their food. Their behaviors and motivations for interacting with keepers are therefore likely influenced by that system and as a result they may have personality dimensions that differ from those of wild sea lions or captive sea lions that are trained using a different system.

The goal of the current study was to establish a starting point for understanding sea lion personality using a measure that would facilitate comparison to other studies and use in future combined coding/rating approaches. We created our survey for use with cumulative keeper ratings using the previously described three-step approach (Freeman et al., 2011; Gosling, 1998).

Methods

Subjects

We studied 18 captive California sea lions (*Zalophus californianus*) that included 8 males (2 pup-juvenile, 6 adult) and 10 females (4 pup-juvenile, 6 adult). Sea lions five years old and older were considered adults (see Table 1 for age, sex and housing information). The sea lions were housed in five different groups among the Wildlife Conservation Society Parks (WCS): Bronx Zoo (N = 5), Queens Zoo (N = 2), Prospect Park Zoo (N = 2), Central Park Zoo (N = 3), and the New York Aquarium (N = 6). Group compositions varied across facilities and included one all male group at the Queens Zoo, two all female groups at the Prospect Park and Central Park Zoos, and two mixed sex groups at the New York Aquarium and Bronx Zoo (see Table 1 for specific age and sex distributions at the different parks). Fifteen of the animals had been born in captivity and three were born in the wild. All sea lions that were rated had been at their facilities for at least one year prior to the survey, but most had been in place for longer. No males were castrated, and pups were naturally weaned.

Survey Construction

Development of the survey was modeled closely after the three-step process used by Gosling (1998). In the first step, a list of 277 traits was generated from three sources: animal personality research (Fagen & Fagen, 1996; Feaver, Mendl, & Bateson, 1986; Gosling, 1998; Highfill & Kuczaj, 2007; Konečná, Weiss, Lhota, & Wallner, 2012; Stevenson-Hinde, Stillwell-

Barnes, & Zunz, 1980; Stevenson-Hinde, & Zunz, 1978; Wielebnowski, 1999), human personality research (Goldberg et al., 2006; Saucier, 1994), and input from an expert panel at WCS. The panel was comprised of three experts on California sea lion behavior who had worked with sea lions for many years, and a fourth individual who had studied personality in several nonhuman species.

In the second step, redundant and non-applicable traits from the list of 277 terms generated in step one were identified and eliminated. The panel examined the list of terms, and items were also eliminated if they were too subjective or unknowable based on observation. Items were replaced with different terms when panel members felt the definition was appropriate but the term was insufficient and/or misleading and added any additional terms the panel thought should be included.

In the third step, the definitions were modified so the behaviors were species-specific and objectively observable. During this step an effort was made to include items of opposite valence (e.g., shy vs. bold) for as many items as possible.

The final survey consisted of 52 personality traits accompanied by a definition with respect to sea lion behavior and 7 “training” traits that were deemed to apply only to training and not personality (Supplemental Appendix A). The training trait responses on the survey were analyzed separately. Raters were instructed to indicate on a Likert scale ranging from 1 “not at all like this animal” to 5 “very much like this animal” the degree to which each trait characterized the individual sea lion. At the top of the survey, raters were asked to give information about the nature (i.e. husbandry, training, enrichment, other) and length of their relationship with each animal.

Raters and Trait Assessment

The raters were experienced sea lion animal care staff at WCS. Raters were instructed to fill out the surveys privately and not to discuss their opinions with other raters. They were asked to complete surveys for as many of the sea lions in their facility as they felt comfortable rating. If animals were moved during or immediately prior to the study, trainers at the location in which the animal had spent the most time filled out surveys on that animal (this occurred for one animal). In total, 49 raters returned surveys for one or all of the sea lions with which they had worked. The number of raters per park ranged from 7 to 13.

Data Analysis

Inclusion criteria and missing values. Surveys from trainers who had at least one year of experience with an animal were included in the data set to ensure that they had sufficient knowledge of the animal to make accurate personality judgments (for all animals who had been at the facility for at least one year). This ensured that trainers had worked with an animal throughout a variety of seasonal occurrences (breeding, pupping, etc.). At least two surveys were required for each sea lion to be included in the analysis.

A small percentage of values were missing (1.3%; 89 out of 6,667). We addressed missing values in the survey by replacing a missing trait score with the mean score on a particular trait, across all sea lions and raters (Morton et al., 2013). This approach is preferred because it does not run the risk of artificially inflating the inter-rater reliabilities of trait items.

Inter-rater reliability of personality ratings. Inter-rater reliability was calculated for each of the 52 trait items as well as all seven training traits. Intraclass correlations (ICCs) were used to assess inter-rater reliability because of their ability to allow for unbalanced designs (Shrout & Fleiss, 1979; see also Furr, 2011). ICC type 3,1 measures the reliability of an individual trait rating, while ICC type 3,k measures reliability of the average of k trait ratings, where k indicates

the number of ratings. As in prior studies (e.g., Freeman et al., 2013), items with ICC(3,1) values above zero were retained for further analysis.

Factor and component analysis. A regularized exploratory factor analysis (REFA) was run on the reliably rated personality traits (Jung & Lee, 2011). REFA yields unbiased estimates of factor loadings with greater precision relative to principal components analysis (PCA) when using small sample sizes (Jung & Lee, 2011). PCA loadings were included for comparison, however the REFA results were used for all subsequent calculations. We employed Horn's (1965) parallel analysis and a scree plot to determine the number of components or factors to extract. We then applied a varimax rotation to the resulting components or factors. Trait loadings from the REFA with an absolute value greater than .3 were considered salient (large enough to suggest a relationship with the dimension on which they loaded). Unit-weighted trait loadings for each factor were multiplied by each animal's mean trait rating and summed; traits with loadings greater than .3 were assigned a weight of +1, traits loading less than -.3 were assigned a weight of -1, and all remaining items were assigned a weight of zero. No trait had cross loadings, (loadings stronger than .3/-.3 on multiple dimensions) so each item was included in the calculation of only one dimension. The resulting scores were converted into *z*-scores for further calculations, and also into *T*-scores ($M = 50$; SD = 10) for interpretability. Inter-rater reliability and internal consistency were then calculated for each dimension using the same ICCs used to assess item reliability and with Cronbach's alphas, respectively.

Mann-Whitney U tests were used to determine whether there were significant differences between the dimension *z*-scores for males vs. females and adults vs. juveniles. Mean training traits ratings were correlated with personality dimensions using Kendall's tau-b correlations

because data were both non-parametric and ordinal. All analyses were conducted using IBM SPSS 22.0 for Macintosh and/or MATLAB 7.12.0.635.

Results

Inter-rater reliability of Personality Ratings

The ratings of 43 trainers were included in the final analysis. In total, 16 sea lions were rated, with an average of seven to eight trainers rating each sea lion (2 sea lions were excluded from the analysis because they did not meet the criterion of having surveys from two raters with at least one year of experience each).

Of the 52 trait items, only 2, "oblivious" and "unaware", had ICC(3,1) estimates that did not exceed zero, and were excluded from further analysis. The remaining values were comparable to reliabilities found in other studies (Iwanicki & Lehmann, 2015; Weiss, King, & Hopkins, 2007). The average ICC(3,1) estimate was .370, ranging from .044 for "perceptive to sea lion behavior" to .644 for "cooperative." The average ICC(3,k) estimate was .761, ranging from .244 for "perceptive to sea lion behavior" to .927 for "cooperative." Although the reliabilities at the lower bound of the range are low, previous studies have included such items, as any value above zero suggests agreement above chance level (Freeman et al., 2013; Weiss et al., 2007). See Supplemental Appendix B for a full table of ICC values.

Factor and component analysis

The criteria we used to determine the number of factors to extract did not converge on one solution; the scree plot suggested a three-factor solution, while the parallel analysis suggested a two-factor solution. After examining both solutions using REFA and PCA with a varimax rotation, we found that the first factor in the two-factor solution (Supplemental

Appendix C) combined the core traits of the first two factors in the three-factor solution (Table 2). The three-factor solution presented groupings of traits that we found easy to interpret

and label, while the two-factor solution was less interpretable. Additionally, the three-factor solution accounted for more variance, at 10.6% (REFA) and 73.0% (PCA). We therefore opted to retain the three-factor solution.

We multiplied the first and third factor loadings by (-1) to reorient (or reflect) them and facilitate interpretability. We labeled these factors "Extraversion/Impulsivity", "Dominance/Confidence", and "Reactivity/Undependability", respectively. The inter-rater reliabilities of individual ratings, i.e., ICC(3,1) estimates for these factors, were .757, .643, and .716, respectively. The inter-rater reliabilities of mean ratings, i.e., ICC(3,k) estimates for these factors were .957, .927, and .947, respectively. The internal consistency reliabilities, i.e., Cronbach's alphas, for these factors were .959, .950, and .951, respectively.

Age and Sex-related Differences. Full results are presented in Table 3. Only Extraversion/Impulsivity showed an age difference with pup-juveniles (n = 6; *Mdn* = 31.64) scoring significantly higher than adults (n = 10; *Mdn* = 23.63). There were no sex differences.

Training Traits. The seven training traits were rated reliably. The average ICC(3,1) for these traits was .425, ranging from .313 for "attentive" to .573 for "eager." The average ICC(3,k) for these traits was .832, ranging from .763 for "attentive" to .905 for "eager." See Supplemental Appendix B for all ICC estimates. The training traits "learns slowly" and "learns quickly" were deemed to capture the same construct and therefore we created a composite variable; "learning ability", defined mathematically as learns quickly – learns slowly.

There were several significant correlations between the personality dimensions and training traits (see Table 4). *Learning ability* and *eager* were positively correlated with both Extraversion/Introversion and Dominance/Confidence, and *compliant* was negatively correlated with Reactivity/Unreliability. None of the other correlations were significant.

Discussion

The primary goal of this study was to characterize personality in captive California sea lions using trait ratings. We found three dimensions that we labeled Extraversion/Impulsivity, Dominance/Confidence, and Reactivity/Undependability. Because we had no previous sea lion personality research with which to compare our findings, we followed the comparison methods described by Gosling and John (1999). Comparisons were drawn if a dimension's core features reflected one of the Big Five factors or a dimension in another species. Because it is difficult to conceptualize the similarities in personality structure between species for which different labels have been used, we created Table 5, which shows where the sea lion personality traits are found in other species. The clustering patterns of traits demonstrate more clearly the process by which we interpreted our dimensions.

According to the REFA, three of the four most strongly loading traits on Extraversion/Impulsivity include *playful, creative, and curious.* These traits are frequently found on dimensions resembling Extraversion, Openness, or both in humans (Goldberg, 1990), chimpanzees (*Pan troglodytes*) (Freeman et al., 2013; King & Figueredo, 1997; Weiss et al., 2009), dogs (Draper, 1995; Jones, 2008), and hyenas (Gosling, 1998). Although *demanding* and *aggressive to sea lions* may seem out of place, both fit with the attention-seeking tendency indicated by the strong loadings of *impulsive* and *jealous*. Additionally, *demanding* has been defined for sea lions as a tendency to solicit attention. In dogs, this trait loads onto Extraversion and Agreeableness (Draper, 1995). Table 5 demonstrates that *aggression* in other species is spread across every dimension (with the exception of the dimension Aggression to Humans). The presence of *aggression* in so many different dimensions could be due to the different contexts that elicit aggressive behaviors in many species. For example, in a review on dog personality

studies, Jones & Gosling (2005) found that *aggression* was assigned to many categories and contexts including Fearfulness, Nervousness, and Dominance. Extraverted and impulsive sea lions may more frequently find themselves in social situations that elicit aggression. Sea lions scoring high on this dimension may be more playful and social than lower scorers. They are also likely to be adept at problem solving, as part of the definition for *creative* in our survey included "tries new ways and approaches to reach its goal." Low scorers, alternatively, may be more solitary and less engaged with others.

Dominance/Confidence in sea lions contains traits related to dominance, but also security and fearfulness (see Table 5). This dimension overlaps, for example, with chimpanzee Dominance (Freeman et al., 2013; King & Figueredo, 1997), hyena Assertiveness (Gosling, 1998), and Hanuman langur Confidence *(Semnopithecus entellus)* (Konečná et al., 2008). Jones (2008) found that in dogs, *fear* and *submissive* load onto Fearfulness, while dominance related traits load onto Aggression Towards Animals. Dominance and aggression are also linked in hyenas (Gosling, 1998), langurs (Konečná et al., 2008), and chimpanzees (Freeman et al., 2013; King & Figueredo, 1997; Weiss et al., 2009); however, no aggressive traits loaded onto the Dominance/Confidence dimension in sea lions. Perhaps in captivity dominance is expressed without the use of aggression or, in these small, relatively stable groups, there are fewer contests for territoriality. Animal care staff may also discourage aggressive behavior through training and so its prevalence may be low. We included Confidence in the label to highlight the non-aggressive aspects of this dimension. Animals who scored high on this dimension are thus secure and probably able to displace others without the use of aggression. This is likely because low scorers are timid, and submit without contest.

Reactivity/Undependability contains traits that reflect low agreeableness and instability. Three traits that load on this dimension (*cooperative*, *friendly to people*, and *aggressive to people*) were defined as relating to humans. As a result, it is only possible to directly compare these trait loadings to those from studies of species that included similar traits. In Gosling (1998) the traits *warm* and *obedient* in hyenas were defined similarly to *friendly to people* and *cooperative*, respectively, in sea lions. These traits loaded onto a dimension labeled Human Directed Agreeableness that Gosling (1998) felt reflected social sensitivity. More specifically, Gosling (1998) suggested that a dimension related to agreeableness towards humans might occur in captive populations in which humans occupy a position of relative dominance in the animal's social environment. This type of dominance relationship with humans also applies to dogs. Jones (2008) and Serpell and Hsu (2001) found that in dogs, behaviors related to aggression and friendliness towards people loaded onto a separate dimension than behaviors related to aggression towards dogs. These findings support the view that this phenomenon may be linked to the ability of social carnivores to understand social hierarchies (Gosling, 1998). Sea lions with high scores on Reactivity/Undependability are likely unpredictable and difficult for both humans and sea lions to approach.

Each personality dimension that we found in this study is compatible with California sea lion behavior in the wild. California sea lions live in large, gregarious groups (Peterson & Bartholomew, 1967). It therefore makes sense that they would vary on a dimension related to social behavior. It is not surprising that a dominance dimension exists, since males fight to defend and maintain territories and females are often described as "quasi-territorial" during the breeding season (Peterson & Bartholomew, 1967). In the wild, males scoring high on Reactivity/Undependability may be more likely to show aggression during territorial disputes.

Females may also manifest this by showing more aggression during the breeding season towards neighboring females.

Training Traits and Personality

All three personality dimensions correlated with at least one aspect of training performance. Extraversion/Impulsivity was most strongly correlated with the training trait *eager* followed by *learning ability*. A willingness to learn (*eager*) and an aptitude at learning (*learning ability*) should both be indicative of good trainability. This is supported by other studies that have shown that Extraversion and Openness traits are associated with faster learning (Coleman, Tully, & McMillan, 2005). Dominance/Confidence was also significantly positively correlated with *learning ability* and *eager*. These correlations are consistent with studies that have shown that bold animals learn faster than shy animals (Savastano, Hanson, & McCann, 2003; Svartberg, 2002). High Dominance/Confidence animals are less neophobic and will approach novel training stimuli and trainers more quickly (Savastano et al., 2003). Reactivity/Undependability showed a significant negative correlation with *compliance.* It is therefore likely that animals that keepers find unpredictable and irritable are prone to ignoring commands or requiring multiple requests. Carere and Locurto (2011) suggested that reactive animals might have difficulty performing certain behaviors due to anxiety.

We found the lack of significant correlation between the trait *breaks often* and any of the personality dimensions particularly surprising. *Breaks often* is defined as a tendency to swim away from a trainer without being asked and/or disengaging from a training session. Coleman et al., (2005) found that exploratory animals tend to lose interest more quickly than others. It is therefore unexpected that Extraversion/Impulsivity did not correlate, as those sea lions display

high levels of *curiosity*. The lack of relationship between personality and breaking might indicate that breaking is driven by something else.

There were no age or sex effects on personality dimensions, with one exception. Pup-juveniles were rated as being higher in Extraversion/Impulsivity than adults. This is consistent with studies that have shown that Extraversion and Openness decrease during adulthood in domestic cats (*Felis silvestris catus*) and snow leopards (*Panthera uncia*) (Gartner, Powell, & Weiss, 2014), chimpanzees (King, Weiss, & Sisco, 2008; Weiss et al., 2007), gorillas (*Gorilla gorilla)* (Kuhar, Stoinski, Lukas, & Maple, 2006), orangutans *(Pongo pygmaeus and Pongo abelii)* (Weiss & King, 2015), and observations of California sea lion behavior (Peterson & Bartholomew, 1967). The lack of sex differences in the Extraversion/Impulsivity dimension is consistent with findings with chimpanzees (King et al., 2008; Weiss et al., 2009) and hyenas (Gosling, 1998). Neither Dominance/Confidence nor Reactivity/Undependability showed age or sex differences. This is not consistent with many other species including chimpanzees (King et al., 2008; Weiss et al., 2007) hyenas (Gosling, 1998), and African lions (*Panthera leo*) (Gartner et al., 2014) in which sex differences in the Dominance dimension are present. Dominance also increased with age in chimpanzees (Weiss et al. 2009) and up to a certain age in orangutans (King & Weiss, 2015). The lack of age and sex differences in the Reactivity/Undependability dimension in sea lions is inconsistent with the similar dimension Agreeableness, in humans (McCrae & Terracciano, 2005), and chimpanzees (King et al., 2008). Both humans and chimpanzees show higher levels of Agreeableness in females, and an increase in Agreeableness with age (King et al., 2008; McCrae & Terracciano, 2005;).

The lack of significant age and sex effects found in our study could be attributable to the different compositions of ages and sexes at each park and/or the small sample size. Age and sex

effects may have been obscured as a result of some of the males being judged relative to one another rather than against females. Furthermore, the social contexts that these animals are in may cause them to behave differently. For example, Peterson and Bartholomew (1967) observed that stable male territories only existed in the presence of females. Perhaps the lack of females at some facilities decreases expressions of male dominance and territoriality.

Our study examined California sea lion personality using a framework that would facilitate cross-species comparisons. However, there were limitations to this study. For one, it focused on the development of a personality survey as a step towards understanding sea lion personality. We envisioned that this survey would be paired with behavioral observations in the future, to both test its validity and improve our understanding of sea lion personality. We therefore did not collect additional behavioral data, and as a result it is difficult to validate our findings. However, the correlations between personality dimensions and training traits suggest that the personality ratings were meaningful.

This study was conducted on California sea lions living in zoological parks and in an environment in which they are fed primarily during training interactions. Although animal care staff ratings should be based on all observations, including those outside of the training context (on exhibit, during vet visits, etc.), the sea lion behavior most salient to care staff likely occurred during their direct interactions with the sea lions. As such, these results may not generalize to sea lions living in environments in which their receipt of food is not contingent on performance or in the wild. Future studies using this survey to assess personality in other populations of captive sea lions and sea lions in the wild would both test its rigor and help to determine differences between how captive and wild sea lions manifest personality traits.

Scientists have called for a better integration of behavioral ecology and personality studies to help gain new insights into personality both human and nonhuman (Sih & Bell, 2008; Weiss & Adams, 2013). For example, Sih and Bell (2008) hoped that we might soon be able to predict behavioral syndromes based on mating systems or ecologies. One step toward this endeavor would be to look into personality similarities in other social carnivores. A further step would examine personality in other species and subspecies of sea lions to further investigate personality differences. With their group living, and advanced cognition, sea lions share traits with very disparate species such as hyenas (Gosling, 1998), dogs (Jones, 2008), and chimpanzees (Weiss et al., 2009). They are a convenient species of marine mammal to research both in captivity and in the wild and could represent a branching point from which to study other species of pinnipeds, caniforms, and other social carnivores.

Table 1. *Age, Sex, and Housing of Sea Lions in the Study*

Sea Lion	Age	Sex	Facility
Butch	22	M	Queens Zoo
Taylor	2	M	Queens Zoo
Nav	9	M	Bronx Zoo
Half-Time	2	F	Bronx Zoo
McCabe	1	F	Bronx Zoo
Indy	9	F	Bronx Zoo
Margaretta	3	F	Bronx Zoo
Beebe	13	F	Prospect Park Zoo
Stella	24	F	Prospect Park Zoo
April	22	F	Central Park Zoo
Edith	3	F	Central Park Zoo
Katie	5	F	Central Park Zoo
Duke	10	M	New York Aquarium
Osborn	13	M	New York Aquarium
Bruiser	4	M	New York Aquarium
Diego	9	M	New York Aquarium

394 Table 2. *PCA and REFA Factor Loadings with Varimax Rotation and Three Factors Extracted*

	REFA Loadings			PCA Loadings		
Trait	E/I[a]	D/C	R/U[a]	E/I	R/U	D/C
Creative	**0.376**	0.147	0.060	**0.871***	0.116	0.366
Playful	**0.375**	-0.015	-0.034	**0.913***	-0.119	-0.046
Demanding	**0.349**	0.232	0.176	**0.744***	0.336	**0.488**
Impulsive	**0.332**	-0.055	0.259	**0.771***	**0.544**	-0.118
Curious	**0.329**	0.167	0.049	**0.840***	0.096	**0.417**
Enthusiastic	**0.317**	0.123	0.035	**0.812***	0.104	0.358
Jealous	**0.313**	0.059	0.194	**0.781***	**0.462**	0.146
Aggressive to SL	**0.307**	0.142	0.258	**0.676***	**0.567**	0.322
Excitable	0.255	-0.139	0.208	**0.663**	**0.528**	-0.328
Lazy	-0.250	-0.110	-0.012	**-0.748**	-0.054	**-0.407**
Diligent	0.250	0.116	-0.020	**0.681**	-0.057	**0.404**
Active	0.241	0.050	0.007	**0.870**	0.019	0.203
Aloof	-0.197	-0.013	-0.070	**-0.702**	-0.228	-0.033
Withdrawn/Asocial	-0.168	-0.042	0.022	**-0.644**	0.099	-0.172
Alert	0.133	0.036	0.011	**0.585**	0.048	0.256
Perceptive of H Behavior	0.110	0.093	0.012	**0.441**	0.016	**0.411**
Insecure	-0.021	**-0.380**	0.156	-0.026	0.367	**-0.871***
Confident	0.118	**0.363**	-0.010	0.267	-0.032	**0.914***
Submissive	-0.209	**-0.353**	-0.071	**-0.419**	-0.172	**-0.810***
Dominant	0.266	**0.340**	0.179	**0.466**	0.366	**0.699***

Neophobic	-0.057	**-0.327**	-0.023	-0.146	-0.048	**-0.879***
Apprehensive	-0.110	**-0.323**	0.050	-0.257	0.130	**-0.792***
Fearful of SL	-0.097	**-0.306**	0.018	-0.229	0.039	**-0.856***
Bold	0.227	0.286	0.087	**0.541**	0.184	**0.684**
Shy	-0.180	-0.274	-0.003	**-0.523**	0.007	**-0.814**
Focused	-0.039	0.241	-0.102	-0.144	-0.321	**0.777**
Calm	-0.191	0.233	-0.218	**-0.502**	**-0.532**	**0.564**
Possessive	0.197	0.225	0.109	**0.483**	0.255	**0.554**
Fearful of People	0.000	-0.211	0.131	0.004	**0.528**	**-0.815**
Unfocused	0.000	-0.204	0.019	-0.004	0.096	**-0.758**
Intelligent	0.142	0.176	0.075	**0.498**	0.236	**0.644**
Flexible	0.121	0.164	-0.160	0.337	**-0.481**	**0.503**
Aggressive to People	0.118	0.061	**0.402**	0.247	**0.926***	0.171
Temperamental	0.152	-0.039	**0.389**	0.346	**0.860***	-0.066
Cooperative	-0.108	-0.022	**-0.368**	-0.267	**-0.867***	-0.068
Irritable	0.108	0.075	**0.360**	0.242	**0.850***	0.213
Friendly to People	0.074	0.035	**-0.303**	0.215	**-0.887***	0.109
Erratic	0.200	-0.070	0.30	**0.516**	**0.719**	-0.176
Testing	0.226	0.019	0.292	**0.548**	**0.690**	0.041
Impatient	0.190	0.067	0.282	**0.486**	**0.735**	0.178
Volatile	0.096	-0.115	0.275	0.294	**0.818**	-0.337
Tense	-0.010	-0.204	0.255	-0.017	**0.603**	**-0.463**
Inflexible	-0.053	-0.032	0.249	-0.122	**0.753**	-0.083

Disobedient	0.138	-0.031	0.243	**0.421**	**0.669**	-0.099
Predictable	-0.201	0.061	-0.227	**-0.566**	**-0.643**	0.170
Obedient	-0.050	0.032	-0.174	-0.203	**-0.563**	0.157
Friendly to SL	0.125	0.028	-0.169	**0.453**	**-0.624**	0.101
Vocal	0.016	-0.071	-0.153	0.036	-0.340	-0.163
Popular	0.088	0.047	-0.142	0.299	**-0.503**	0.187
Perceptive of SL Behavior	0.096	-0.006	-0.127	0.436	**-0.612**	0.000
	Cumulative %: 10.6			Cumulative %: 73.02		

Note: Salient loadings are in boldface (>|.4| for PCA, >|.3| for REFA), E/I = Extraversion/Impulsivity, D/C = Dominance/Confidence, R/U = Reactivity/Unreliability, H = Human, SL – Sea Lion

*Salient traits from the REFA analysis.

[a]Loadings have been reflected

400 Table 3. *Mann-Whitney U Age and Sex Differences in each dimension*

	U	*p*	*z*	*r*
Males vs. Females				
Extraversion/Impulsivity	23	.368	-.900	-.225
Dominance/Confidence	26	.560	-.583	-.146
Reactivity/Undependability	24	.427	-.794	-.199
Pup-Juveniles vs. Adults				
Extraversion/Impulsivity	8	.017	-2.39	-.597
Dominance/Confidence	28.5	.871	-.163	-.041
Reactivity/Undependability	21	.329	-.976	-.244

401 *Note: p*-values are two tailed

Table 4. *Kendall's tau-b Correlations between Personality Dimensions and Training Traits*

Dimension	Attentive	Breaks Often	Challenging	Compliant	Eager	Learning Ability
Reactivity/Undependability	.03 (.856)	-.14 (.442)	.33 (.078)	-.47 (.013)	.07 (.717)	.25 (.190)
Dominance/Confidence	.33 (.077)	-.25 (.175)	-.36 (.058)	.09 (.650)	.39 (.037)	.52 (.006)
Extroversion/Impulsivity	.17 (.366)	-.14 (.442)	.04 (.821)	-.33 (.077)	.68 (.000)*	.58 (.002)*

Note: *p*-values are two-tailed. *Correlations significant after Holm-Bonferroni correction.

404 Table 5. *Mapping of Sea Lion Personality Traits onto Commonly Found Personality Dimensions in Chimpanzees, Humans, Hyenas,*

405 *Langurs, and Dogs*

Table 5.

Sea Lion Dimension	Trait	EXT.	AGR.	EMO. STA.	OPN. INT. TRN.	CON.	DOM. FER.	AGG. HUM.	AGG. INTRA.
E/I	Creative	C, L			C, H, Y				
	Playful	H, C, D,			C, D, Y		L		D
	Demanding	D	D						
	Curious	D, L, C			C, H, Y		L		
	Impulsive	L	L	C	Y	C			
	Enthusiastic	H							
	Jealous	L	L	H, C	C	C	Y		
	Intraspecific Aggression	C	H, D, L	C	D	C	C, Y, L		D

R/U	Human							D		
	Directed									
	Aggression									
	Temperamental			H, C, Y						
	Cooperative		H, C, Y		D					
	Irritable		H, L	C		C	Y, L			
	Friendly to		Y		C			D		
	People									
D/C	Insecure			H						
	Confident						Y, L, D			
	Submissive	H					C, D, L			
	Dominant	H	L	C			C, L		D	
	Neophobic									
	Apprehensive	L	L		C		C			
	Fearful			H, C			C, D, L, Y			

406 *Note:* EXT (Extraversion), AGR (Agreeableness), EMO STA (Emotional Stability), OPN INT TRN (Openness, Intellect,

407 Trainability), CON (Conscientiousness), DOM FER (Dominance, Fearfulness), AGG HUM (Aggression to Humans), AGG INTRA

408 (Intraspecific Aggression)

409 E/I (Extraversion/Impulsivity), R/U (Reactivity/Undependability), D/C (Dominance/Confidence)

410 C = chimpanzees, H = humans, Y = hyenas, L = langurs, D = dogs

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Acknowledgements

We thank Martin Chodorow, Hani Freeman, Mareike Gartner, Kathy Carlstead, Sam Gosling, and Sarah Brosnan for statistical counsel; Martha Hiatt, Melissa Nelson, and Jessica Moody for help with survey development; the staff at the Wildlife Conservation Society for volunteering to participate in this study, and the Animal Behavior and Conservation department at Hunter College for supporting this project. This study is based on a Master's thesis completed by Lillian Ciardelli as part of the degree requirements for Hunter College's Animal Behavior and Conservation Masters Program, in the Psychology Department.